I have always had a passion for solving problems, enjoyed challenges, and pushed myself to overcome any obstacle. When I was seven and going to public school in Spain, I would beg my teacher to give me more math problems to practice, instead of attending English class. In 6th grade, the material we were learning in math was rudimentary, so I signed up to join the Math club to challenge myself. Unfortunately, my efforts were thwarted when my teacher informed me the club was for students who needed extra tutoring. Because I loved competition and enjoyed the exercise I threw myself into sports because even though I was undersized, I was the most determined and yearned to improve. I wanted to “be the ball” as an aspiring soccer player in Spain, I spent hours practicing catching outfield fly balls with my dad in middle school, and as a chubby highschool freshman I would spend a whole year training with the track and cross-country team to earn a spot on the varsity soccer team. My determination and broad perspective are essential to my motivations of becoming a researcher.

I first knew that I would dedicate my career towards integrating distributed renewable energy (DER) during a three-day backpacking trip I took with my father in the Rocky Mountains. Nearing the completion of the hike, I climbed up to a vantage point and was completely isolated. I could not believe the beauty and the grace of my surroundings but could not shake the dreadful thought that climate change and pollution would destroy this breathtaking landscape in only 20 years. In that moment decided to would devote my career to Power and Energy Engineering so I could work toward preserving our planet by transforming the grid to use clean energy.

Prior to this self-discovering moment, I was originally planning on pursuing a career in hardware and software development because it seemed to be the perfect mix of physical constraints and limitless possibilities of coding. Pursuing this interest, I worked for the Cooperative Engineering Program at Bridge Fusion Systems LLC (BFS), a tiny electrical engineering consulting company that specialized in hardware projects. As only the third employee at the company, I eagerly started working on meaningful hardware projects. My first project was to design code and tinker with a small test fixture to be used to swiftly load and calibrate microcontrollers that would eventually be installed in wi-fi compatible Smart Plugs. At the end of my rotation I installed the test fixture and accompanying software at a manufacturing company. I recently learned that these smart plugs are now being installed in two Pittsburgh buildings and could save the city $6.3 million in energy costs over the next 10 years[1]. Learning how to set up, develop, debug, and complete professional projects was an invaluable skill that I was able to apply to school and undergraduate research.

To apply what I had learned at BFS towards sustainability I volunteered my time to improve and advance projects in a Sustainable Design lab at Pitt. I joined a small team of undergraduate students working on building low-cost microcontroller-based air quality sensors. My teammate’s backgrounds with microcontrollers were limited and the circuits being built for the sensors were difficult to debug and tedious to build, so they were struggling to move their project along. I was able to quickly identify problems with the circuits but ultimately recommended changing the implementation of the project because of the lack of resiliency in the microcontrollers they were using. Another team in this lab was testing how ultraviolet LEDs could be used to decontaminate water. Unfortunately, their circuit design and implementation prevented the LEDs from being operable, so I redesigned their code and adjusted their circuitry so they could control and record the intensity of the light. Working in this lab allowed me to collaborate with engineers outside of my field of study and provided the opportunity to apply my skills to benefit sustainable projects.

To widen my scope of understanding, take advantage of opportunities available at a research driven university, and use my engineering skills to benefit the environment I contacted Dr. Thomas McDermott because he was leading research projects focused on sustainability. The project I began with Dr. McDermott would last over three summers and was my introduction to the field of Electric Power. The goal was to develop a process to quickly convert Duquesne Light Company’s (DLC), the local electric utility in Pittsburgh, distribution circuit maps into testable models. In 2015 DLC was beginning to see interest for distributed photovoltaic (PV) generation on customer’s homes. The traditional techniques used by DLC to analyze their circuits were not sophisticated enough to study the impact distributed PV would have on their circuits and thus forcing DLC to limit the PV penetration to a measly 15% threshold. The models I was designing would allow for individualized analysis to adjust the PV threshold for each circuit.

After two summers of designing the process to build circuit models the project was still incomplete but I was determined to apply my models to increase the PV penetration in Pittsburgh, so I pursued an internship at DLC. As an intern I was able to enhance the model building process but more importantly I designed studies to assess the impact PV had on a circuit. Using the PV Integration Handbook (source) and DLC safety thresholds as my main guides, I designed a voltage study and a fault study that could be conducted on the circuit models. I chose two circuits to study with high levels of PV penetration and was able to conclude that both circuits had little or no safety concerns in their current state and additionally both circuits had potential to handle higher levels of PV. Since this was the first study of its kind at DLC and my method of building circuit models uniquely did not require any Geographic Information System data we decided to publish a conference paper at the 2018 IEEE Power and Energy Society general meeting on the project, where I was the primary author [2].

My experience with DLC was a big motivating factor to continue learning about the power industry. The systems and data they were using to manage their distribution circuits were outdated compared to other industries. The models I was designing, were only a band-aid; what DLC really needed was a revolution to adapt new technologies and change the way problems are thought about being solved. To get a more general philosophy behind the power industry, a universal methodology for understanding the tradeoff among different approaches in practice, and pioneering a research angle for innovating the game, it was necessary to go to graduate school.